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ABSTRACT

This student module on agricultural chemical and pesticide hazards is one of 50 modules concerned with job safety and health. This module contains information concerning the safe handling, use, and storage of many chemicals that are frequently used in the control of pests. Following the introduction, 10 objectives (each keyed to a page in the text) the student is expected to accomplish are listed (e.g., Explain two ways pesticides are likely to be ingested). Then each objective is taught in detail, sometimes accompanied by illustrations. Learning activities are included. A list of references and answers to learning activities complete the module. (CT)

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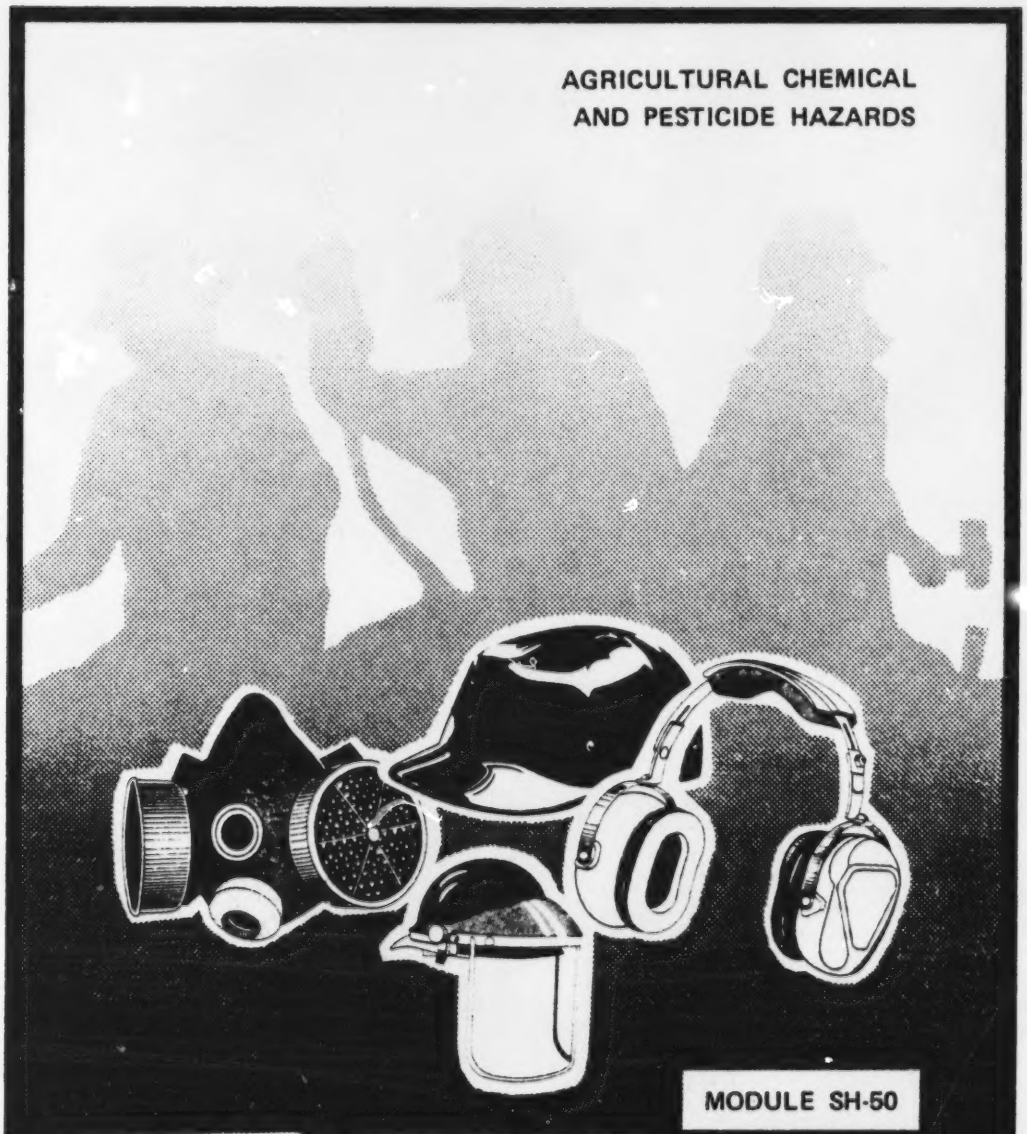
SAFETY AND HEALTH

AGRICULTURAL CHEMICAL AND PESTICIDE HAZARDS



MODULE SH-50

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INTRODUCTION

Agricultural productivity in the United States has increased enormously during the half century between 1930 and 1980. This increase has been due mainly to two changes in farming practices, (1) the introduction of mechanical devices to replace much of the human and animal effort previously used, and (2) the development of chemical substances to control pests and to increase plant and animal growth and production.

As is the case with most new developments, the great benefits arising from the changes have been accompanied by some problems. One of those problems has to do with the safe use of agricultural chemicals and pesticides. Specifically, there are two areas of concern: the safety of the people who use the chemicals, and the safety of the environment in which the chemicals are used.

According to the Bureau of Labor Statistics reports for 1977, only the construction and manufacturing industries had higher rates of job-related injuries and illnesses than did the agricultural industries. Of every 100 persons employed in agricultural production and services, over 11 have experienced some work time lost because of work-related accident or sickness. These figures emphasize the need for more concern with all aspects of safety in the agricultural industries.

This module contains information concerning the safe handling, use, and storage of many chemicals that are frequently used today in the control of pests. These chemicals are used in both urban and rural environments, and in the growing of food crops and ornamental plants.

OBJECTIVES

Upon completion of this module, the student should be able to:

1. Briefly define an agricultural chemical and a pesticide, and name three governmental agencies involved in regulating these substances. (Page 3)

2. List one way to help prevent chemicals from entering the body by each of the three common routes of entry. (Page 4)
3. Name two hazards other than poisoning that are associated with the handling and use of agricultural chemicals, and describe measures that should be taken to avoid these dangers. (Page 6)
4. Compare three ways chemicals can cause problems when contacting the eyes, and explain suitable first aid procedures. (Page 8)
5. Name two types of protective devices used to avoid eye contamination when working with chemicals. (Page 10)
6. Identify the most common method of contamination from pesticides, how they affect the body, and four protective measures to avoid such contamination. (Page 11)
7. Describe first aid procedures for a person who has inhaled poisonous fumes, and tell what protective measures can be used to avoid inhaling chemical vapors. (Page 13)
8. Explain two ways pesticides are likely to be ingested. (Page 16)
9. Describe precautionary measures to take when storing and mixing chemicals, cleaning up leaks and spills, and disposing of chemical wastes. (Page 17)
10. Discuss the use of labels and manufacturer's directions for storage and use of chemicals and pesticides. (Page 21)

SUBJECT MATTER

OBJECTIVE 1: Briefly define an agricultural chemical and a pesticide, and name three governmental agencies involved in regulating these substances.

Agricultural chemicals are those substances or mixtures of substances that are commonly used in the production or protection of food, fiber, and forest products. These include the fertilizers that encourage plant growth and the pesticides that control unwanted plants, animals and disease organisms.

The word "pesticide" literally means "pest killer." There are many specific pesticides among which are: herbicides which kill plants, rodenticides which kill rodents (rats and mice, primarily), and insecticides which kill insects. Some of these may also be capable of killing the workers who use them.

The use of all potentially hazardous agricultural chemicals is regulated by several state and federal agencies. The United States Department of Agriculture (USDA) and the Environmental Protection Agency (EPA) both have broad, general, regulatory powers over agricultural chemicals. These agencies set general and specific standards that must be met before certain of these chemicals can be used.

The safety of agricultural and chemical workers who work in the production of pesticides is also a concern of the Labor Department's Occupational Safety and Health Administration (OSHA). The purpose of the Occupational Safety and Health Act of 1970 is "...to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources." This agency's authority extends to such things as the type of protective clothing that must be worn while using hazardous substances, and the concentration of substances that is permissible in the air that workers breathe.

ACTIVITY 1:*

1. Define and describe an agricultural chemical and a pesticide.

   a. _____

   _____

   b. _____

   _____

2. Name three federal agencies that have some control over the handling and use of agricultural chemicals.

   a. _____

   b. _____

   c. _____

OBJECTIVE 2: List one way to help prevent chemicals from entering the body by each of the three common routes of entry.

The number of governmental agencies that are involved in the regulation of agricultural chemicals is an indication of the serious consequences of the misuse of these valuable products. Humans, as well as other forms of life, can be sickened or killed by such chemicals. Careless, deliberate contact with some of these substances, or accidental, even indirect, contact with the more toxic (posionous) ones, can be deadly.

Substances that cause harm to humans may enter the body by one of three routes (Figure 1). One route of entry is through the ingestion process. Ingestion occurs when a substance is taken into the mouth and swallowed. Accidental ingestion of chemicals can happen when a worker eats contaminated food, or drinks contaminated water. To avoid these problems, food and drink must be kept isolated from areas of potential contamination; hands should be washed thoroughly before handling food and drinks.

*Answers to Activities begin on Page 26.

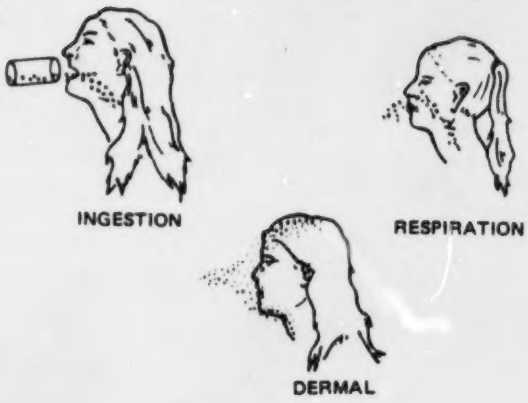


Figure 1. Routes of entry into the body.

A second route of entry is the breathing (respiration) of contaminated air. Ways to avoid contamination of the respiratory tract include the wearing of proper respirators and the use of appropriate ventilation equipment. Care in handling and storage may also reduce the level of airborne contaminants.

The most common form of contamination (dermal) occurs through the skin. Since many chemicals are handled during mixing, use, and storage, contamination through the skin is a major problem. Wearing protective clothing such as rubber or neoprene gloves is one way to reduce this hazard. Removing contaminated clothes and carefully washing the skin with soap and water will also reduce the possibility of dermal contamination.

The labels of all chemical containers should be read thoroughly before chemicals are handled. Then, if accidental contamination occurs, the label will have supplied information about what must be done to prevent illness or even death.

ACTIVITY 2:

1. Toxic chemicals can enter the body through _____, _____, or through contamination of the _____.
2. Name one way to prevent chemicals entering the body through each route of entry.
   a. _____
   b. _____
   c. _____

OBJECTIVE 3: Name two hazards other than poisoning that are associated with the handling and use of agricultural chemicals, and describe measures that should be taken to avoid these dangers.

The letter "N" on a fertilizer sack, and the middle letter in "TNT" stand for the same element, nitrogen. Compounds of nitrogen are often capable of exploding with enormous force; guncotton (an explosive) is made by coating fibers with such a material. Large stores of fertilizer have been involved in a number of disastrous fires. One such fire and explosion occurred in Texas City, Texas, in 1947, and took several hundred lives while destroying a large part of the town's industrial waterfront.

Even when relatively small quantities of many chemicals are used or stored, there exists a definite fire hazard. When chemicals are purchased and stored, they should be handled in accordance with label directions to prevent the hazard of fires and explosions.

The degree of danger involved with a particular chemical in liquid form is often indicated by its "flash point." The flash point is that temperature at and above which the chemical forms explosive vapors. Low flash points thus mean more danger. Substances having flash points at or below 20°F must be labeled: DANGER - EXTREMELY FLAMMABLE! KEEP AWAY FROM SPARKS AND HEATED SURFACES. For chemicals with flash points between 20° and 80°F, the warning statement must read, "Warning - Flammable! Keep away from heat and open flame." Those chemicals that have flash points over 80°F but not over 150°F must be labeled, "Do not use or store near heat or open flame."

Certain chemicals in powder form also present fire and explosion hazards. Sodium chlorate will ignite when in contact with organic matter, sulfur, sulfides, phosphorus, powdered metals, strong acids, or ammonium salts. Once a container of sodium chlorate has been opened, the entire contents should be used. Dusts or powders, especially the very fine ones, may ignite and burn as violently as gases. Grain elevator explosions are examples of the violent results of ignited dusts.

The safe storage of all agricultural chemicals, including fuels and solvents frequently used in farming operations, requires that fire extinguishers be readily available. All workers whose duties under their employer's emergency action plan include the use of chemicals should know the location of fire fighting equipment, the type of equipment available, and the correct procedure for its use. Information about the classifications of fires and the correct extinguisher to use for each type of fire is given in Figure 2.

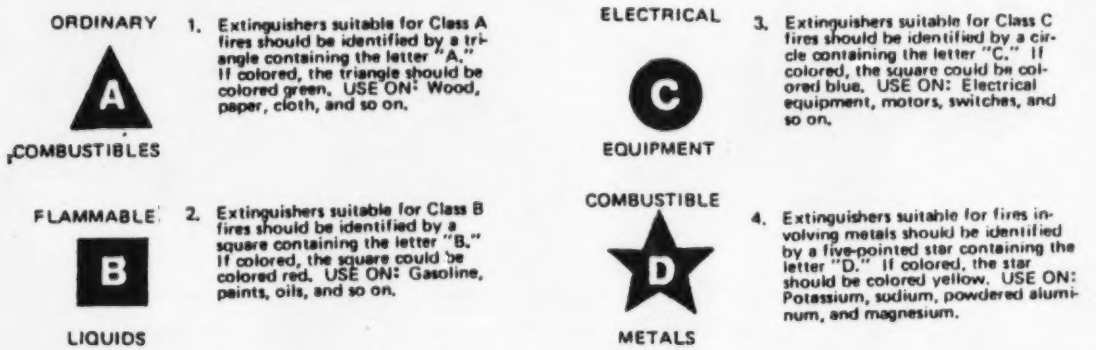

ORDINARY
A
COMBUSTIBLES
1. Extinguishers suitable for Class A fires should be identified by a triangle containing the letter "A." If colored, the triangle should be colored green. USE ON: Wood, paper, cloth, and so on.
ELECTRICAL
C
EQUIPMENT
3. Extinguishers suitable for Class C fires should be identified by a circle containing the letter "C." If colored, the square could be colored blue. USE ON: Electrical equipment, motors, switches, and so on.
FLAMMABLE
B
LIQUIDS
2. Extinguishers suitable for Class B fires should be identified by a square containing the letter "B." If colored, the square could be colored red. USE ON: Gasoline, paints, oils, and so on.
COMBUSTIBLE
D
METALS
4. Extinguishers suitable for fires involving metals should be identified by a five-pointed star containing the letter "D." If colored, the star should be colored yellow. USE ON: Potassium, sodium, powdered aluminum, and magnesium.

Figure 2. Fire extinguishers.

Chemical spills and leaks may accompany fires or explosions. In the event of such an accident, it is necessary to take action to protect human life and health, livestock and wildlife, and the environment. Massive spills produce both immediate and long term results, many of which are not well understood at this time. However, more specific information can be found in the "Hazardous Materials - Emergency Action Guide."[1] Because there is so much that is not known about the effects of chemicals, it is particularly important that care be taken to see that all safety regulations are observed in the storage and handling of these substances.

[1] "Hazardous Materials - Emergency Action Guide." U.S. Department of Transportation National Highway Traffic Safety Administration, 1976.

Manufacturers of agricultural chemicals, with help from governmental agencies, have devised new types of containers that resist rust and punctures. Tank cars for railway transport of chemicals have been strengthened so that they resist rupture even in a collision or derailment. It is very important that proper containers be used at all times. No flammable liquid should be transferred into a glass container that might break and cause a spill. The directions on the label of a dangerous chemical specify the conditions under which the chemical is to be stored. As with all package instructions, these must be observed!

ACTIVITY 3:

(Fill in the blanks.)

1. Two accident hazards, other than poisoning, that are associated with the use of agricultural chemicals are: _____ and _____

   _____

2. Workers who deal with chemicals should know what three things about fire control?

   a. _____

   b. _____

   c. _____

OBJECTIVE 4: Compare three ways chemicals can cause problems when contacting the eyes, and explain suitable first aid procedures.

One of the routes through which chemical poisons can enter the body is the skin, and the eye is the most vulnerable skin area. Chemicals in solid, liquid, and gaseous forms find their way into unprotected eyes. Solid particles can irritate the delicate eye tissues by scratching or cutting the eyelid or the surface of the eyeball. Solids can also produce chemical irritation when they are dissolved by tears and react with the living tissue.

Liquid forms of chemicals can produce the same type of tissue irritation, and they also can produce thermal (temperature) injury if they are unusually hot or cold.

Chemical vapors, the gaseous form in which many agricultural chemicals are applied, can produce chemical irritation on contact with the eye. Even substances that have a low level of toxicity may produce damage when accidentally introduced into the eye. Eye damage from chemicals ranges from the irritation that results from solid particles, through simple burning and redness, to total blindness. Damage from chemicals can also be systemic (affecting the entire body system) due to the absorption of chemicals into the whole body through the mucous membranes that line the eye socket.

A stinging or burning sensation is usually the first indication that foreign substances have entered the eyes. If such burning occurs, the eyes should be flushed immediately and continuously for 15 minutes with large amounts of clean water. When this is done, the person should seek medical attention in all but the most minor cases. It is important in the case of chemical injury to the eye, or to any body part, to follow all special first aid instructions included on the product label. Existing laws now require that such information be on EVERY hazardous product.

ACTIVITY 4:

1. Mark "True" in the blank beside each correct ending for this sentence.
   Chemicals accidnetally introduced into the eyes may
   _____ (a) cause blindness.
   _____ (b) change eye color.
   _____ (c) enter the whole system.
   _____ (d) scratch or cut the eye.
   _____ (e) cause near-sightedness.
   _____ (f) reduce the eye's size.
2. Complete the following sentence.
   The first and most important thing to do if chemicals get into the eyes is _____
   _____

OBJECTIVE 5: Name two types of protective devices used to avoid eye contamination when working with chemicals.

Since the eyes are an extremely vulnerable and sensitive area of the body, protecting them from damage should be a prime concern for every worker. Many agricultural chemicals are harmful to the eyes, so safety glasses should be worn as a minimum protection at all times. Additional safeguards may be needed, depending on the chemical being used. Contact lenses typically increase the sensitivity of the eyes and make them more vulnerable to irritating fumes or chemical contamination. It is advisable, therefore, to avoid wearing contact lenses when continued exposure to potential chemical hazards exists.

Besides safety glasses or chemical splash goggles, a face mask or face shield should be considered when use of chemicals, or short term use of very hazardous chemicals, is likely. These devices may be used in combination with one of several types of respirators that protect the breathing processes as well as the eyes.

In addition to wearing proper protective devices, wiping off facial sweat should never be done by using the hands or shirt sleeve. Clean, disposable towels are recommended as a proper substitute.

ACTIVITY 5:

Two devices that can be used to protect the eyes while working with chemicals are _____ and _____.

OBJECTIVE 6: Identify the most common method of contamination from pesticides, how they affect the body, and four protective measures to avoid such contamination.

Poisoning from the handling and use of pesticides is most lifely to occur through the skin. The most obvious route of entry is through a break in the skin resulting from a cut or scratch. Where skin is damaged, extra caution must be observed to avoid contamination. Rubber or plastic gloves and aprons are often used to afford this type of protection.

Even skin that is unbroken can permit chemicals to enter the body. This is especially likely where there is much body hair. The hair itself tends to hold the chemicals, and the hair follicles allow the chemicals to get beneath the tougher outer skin. Those chemicals that are potent solvents can actually poison by penetrating the unbroken outer skin. They do this by dissolving the fatty parts of the skin cells, thereby opening tiny holes through which the chemicals can pass.

Among the actions that workers can take to protect themselves from chemical damage through the skin are the following:

- Wash the body thoroughly after all exposures to chemicals (pay particular attention to washing hair and fingernails).
- Wear clean clothes each day, and be sure contaminated clothing is completely washed and rinsed. (Note: if clothes are washed at home, care should be taken not to expose other family members to the chemicals).
- If working around liquid chemicals, wear water-resistant shoes or boots (not leather or fabric).
- Use all protective gear available.
- Seek medical help if symptoms of poisoning appear.

Symptoms of poisoning from a given chemical are usually similar, regardless of the route of entry into the body. The symptoms will vary with the type of chemical involved, with the quantity of exposure, and with the physical size and condition of the person poisoned. The major groups of chemicals that have been involved in injury to the technicians working with them are the following:

- Organophosphates, whose symptoms begin within 12 hours of exposure.
- Carbamates, whose symptoms are similar to the organophosphates but can be treated more readily.
- Chlorinated hydrocarbons, which have poisoned very few applicators, but can contaminate the environment.
- Nitrophenols and pentachlorophenols, which have a very rapid course of illness - the patient usually either dies or gets well within 24 to 48 hours of exposure.
- Inorganic pesticides, which depend for their poison effect upon the mineral from which they are made.
- Plant-derived pesticides, which range in toxicity from rotenone dust, which irritates the respiratory tract, to nicotine, which is a very dangerous, fast-acting nerve poison.

Among the symptoms that are common to poisoning from many of the chemicals are nausea, headache, dizziness, rapid breathing and heartbeat, loss of coordination, blurred vision, unconsciousness, and difficulty in breathing. In severe cases, death can come rapidly if the victim is not treated promptly.

ACTIVITY 6:

1. Place an "X" by each of the following that is NOT normally a common symptom of poisoning.

   ____ (a) Tingling in feet and hands.
   ____ (b) Loss of coordination.
   ____ (c) Earache.
   ____ (d) Loss of balance.
   ____ (e) Nausea.
   ____ (f) Headache.
   ____ (g) Rapid heartbeat.
   ____ (h) Difficult breathing.

2. Name four methods that will reduce the likelihood of contamination of the skin when using pesticides.

   a. _____
   _____
   b. _____
   _____

c. _____

_____

d. _____

_____

OBJECTIVE 7: Describe first aid procedures for a person who has inhaled poisonous fumes, and tell what protective measures can be used to avoid inhaling chemical vapors.

When someone has been exposed to poisonous fumes, it is urgeny to get that person to fresn air as quickly as possible. However, before entering an area to aid a victim, the rescuer must be sure that the atmosphere is safe, or chance becoming a victim as well. If the victim is breathing, he or she should not be "slapped on the back" or subjected to any procedure designed to "help" breathing. If breathing has stopped, then one person should begin rescue breathing or CPR procedures while another person goes for medical help. Again, getting the victim to fresh air is the first priority. Permanent, irreversible damage can be done to lung tissue by even very brief exposures to poisonous fumes. Scarring of the lungs reduces the body's ability to take oxygen and give off waste gases. Lung scarring also makes the body more susceptible to diseases such as pneumonia and bronchitis.

The lungs are one of the routes by which poison can enter the entire body. One breath of cyanide, which is sometimes used to fumigate dried seed, has been known to be fatal. Cyanide kills by combining with red blood cells in the lung in such a way that the red cells cannot take up oxygen to carry to parts of the body.

Because prevention is always better than treatment, it is important for pesticide users to know the various types of respiratory protective devices that are commonly used. The label on some pesticides specifies the type of respiratory device most suitable. Protection is especially important in the following situations:

- When working with a highly toxic chemical.
- When exposure for long periods is expected.
- When working in an enclosed area.

One type of respirator that is recommended for use with poisonous agricultural chemicals is the chemical cartridge respirator (Figure 3a). It should be worn during exposure to intermittent concentrations of a toxic pesticide. With this type of respirator, air is inhaled through a filter pad and a cartridge made to absorb pesticide vapors. These half-face masks cover the nose and mouth and remove most harmful vapors, gases, and particles from the air. Separate goggles can be worn to protect the eyes.

A chemical canister respirator, or gas mask, (Figure 3b) should be worn when one is exposed to a continuous concentration of toxic pesticide. This type of respirator affords greater protection than the cartridge type respirator, but should not be used in situations in which the oxygen supply is low (such as when working in a silo).

Figure 3c illustrates a air-supplied respirator that can be used when the oxygen supply is low, when working with toxic chemicals in an enclosed area (as in fumigation), and when work can be done near a supply of clean air. Clean air is pumped through a hose to the face mask.

A self-contained breathing apparatus (Figure 3d) can be used under the same conditions as the air-supplied respirator except that the user does not have to be near a supply of fresh air. This unit includes a tank of air that is carried on the back, allowing greater freedom of movement for the worker.

To be effective, any protective device must be cleaned and maintained properly. The face shields or masks should be washed daily after use. Cartridges must be replaced according to manufacturers' schedules, and air tanks must be kept charged. Hoses and connections should be checked for leaks on a scheduled basis.

The descriptions included here are meant to present an overview for the use and function of various respirators. All workers in a position to need one of these devices should receive proper training in its use and care before using it in an actual, hazardous, work situation.

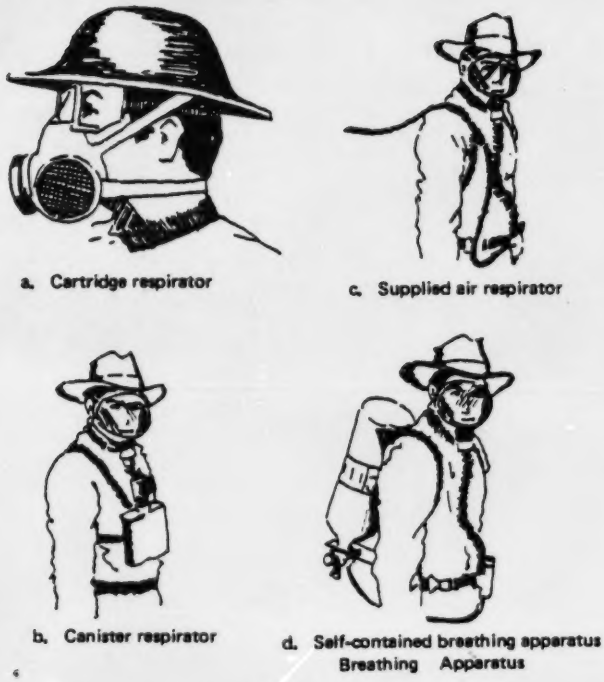


Figure 3. Respiratory protective devices.

ACTIVITY 7:

List four types of protective devices for use around poisonous gases and vapors, describing when each should be used.

1. _____
2. _____
3. _____
4. _____

OBJECTIVE 8: Explain two ways pesticides are likely to be ingested.

To ingest means to take into the body through the mouth. Poisons and toxic chemicals pose a serious threat to life and health when taken into the body in this way. Listed below are some of the common-sense rules that can help to prevent the accidental ingestion of poisons.

1. Never eat, drink, smoke, or chew gum or tobacco while handling toxic chemicals.
2. Keep all poisons in their original containers. (Many small children have been poisoned by chemicals that were stored in food containers.)
3. Use protective clothing and devices while transferring or mixing chemicals where splashing is a possibility.
4. Shower, using soap and warm water, after handling pesticides or other toxic chemicals. Wash thoroughly any eating or drinking utensils that may have been contaminated.

Toxic chemicals are taken into the body with food and water that has been contaminated. Care must be exercised when using pesticides to ensure that the chemical does not drift or run off into waterways, wells, or ponds. Both human and lifestock food must be protected when pest control operations in storage areas are begun. When food crops are treated with pesticides, a certain amount of time must pass before it is safe to harves the crop. The time varies with the crop and the poison, and the time required will be stated on the pesticide label.

The symptoms of pesticide poisoning do not differ significantly with various routes of entry into the body. However, the rate at which the symptoms appear may vary, depending on the route of entry and the chemical toxicity. Some of the common symptoms were listed earlier in this module. It is important to note that many of these symptoms are similar to those of colds, "virus attacks," asthma, heat stroke, and pneumonia. Pesticide poisoning should be suspected any time a person shows signs of illness after using or being around these chemicals. Some product labels list the symp-

toms of poisoning with specific measures that should be taken if such poisoning occurs.

If a poisonous substance is accidentally taken into the mouth, the first action should be to wash the mouth liberally with clean water. The victim should then be taken to a doctor or hospital for medical care. Larger cities often have emergency medical care and poison control centers available. (This is not the case in rural areas.) Medical care should be obtained any time toxic substances are ingested. The container label should be taken for medical personnel to use. Do not induce vomiting unless the package label directs that action. Some chemicals do even more damage when vomiting occurs. Medical facilities often do gastric lavage (stomach pumping) to remove any remaining poison. This is to avoid the danger of the patient aspirating the fluid (breathing it into the lungs).

ACTIVITY 8:

Name two ways that toxic chemicals can be accidentally ingested.

1. _____
2. _____

OBJECTIVE 9: Describe precautionary measures to take when storing and mixing chemicals, cleaning up leaks and spills, and disposing of chemical wastes.

The safe and effective use of pesticides and other agricultural chemicals requires care, attention, and knowledge at every step of the process, from initial selection to final disposal. Before the chemical is purchased for home, farm, or commercial use, an exact determination of the purpose to which the product is to be put must be made. One of the first, and probably the best known of the modern day pesticides is DDT. When it was first released, DDT was widely hailed as the solution to the insect problem, and was used in all kinds of situations with a "shot gun" approach. After a time, however, insect resistance to the effects of DDT

The "shot gun" approach has now been replaced with a new awareness that a specific chemical should be used, in the approved manner only, to treat a specific problem. Therefore, before a person can select the appropriate chemical. the problem must be identified. The U.S. and State Agricultural Extension Service can be very helpful in identifying soil deficiencies, insects, fungi, and other problems, and in recommending the proper treatment. Many chemical pesticides are carefully regulated with specific training and certification required before purchase or use. These chemicals are considered very hazardous and should not be used by untrained workers.

When the correct chemical has been selected and secured, storage and handling become the next area for concern. The amount of a pesticide on hand should not be greater than necessary to meet foreseeable needs. The danger associated with the stored pesticides is related to the quantity stored, the age of the stock, and the place and conditions of storage. Danger in handling comes primarily from lack of awareness of proper procedures and from failure to observe known rules.

The proper equipment for each job is essential to safe operations, both in agriculture and in other businesses. Tanks, valves, mixing devices, and nozzles should be clean and correctly adjusted before they are put into use. Hoses should be inspected for signs of weakness and cuts that could permit leaks. Equipment should not be overloaded, as this can lead to spills and to improper mixing or distribution. Training in the use of equipment is usually available from dealers or manufacturer's representatives, and is a part of formal training courses offered by schools and the Extension Service. Safe and efficient operation of equipment depends upon understanding the correct use for each piece of equipment and on complying with directions found on the labels and in the booklets that come with the products.

A simple safety technique that should never be ignored is known as the "Buddy System." This means that an individual never uses hazardous chemicals alone. Workers should form a team with at least two members, so that if one encounters a problem, the other will be there to help. All team members should be thoroughly acquainted with the chemical, its handling and

use, hazards, contamination symptoms, and first aid requirements. Awareness of the symptoms of pesticide poisoning, listed earlier in this module and also listed on product labels, will aid a partner in detecting signs of a developing problem in time to seek help.

A particularly hazardous part of any chemical use is the mixing operation. Every person working directly with chemicals that are being mixed or transferred from one container to another should make use of appropriate protective gear, such as face masks, goggles, respirators, aprons, waterproof boots, gloves, and so on. Mixing of chemicals should be done out-of-doors, if possible. If the operation must be performed in an enclosed area, adequate ventilation is essential. The amount to be mixed should not be greater than the approved capacity of the applicator container. Livestock, pets, and people who do not need to be present should be kept away from the mixing area. If there is a breeze in the mixing area, the worker should stand so that the breeze blows away from the body to avoid contamination from blowing dust or mist. However, natural ventilation cannot be depended upon for protection against harmful exposure.

Before a pesticide is mixed, directions should be read completely. The operator should not rely on memory, particularly since the instructions for mixing differ for various chemicals. Sealed paper containers should not be torn open. The paper should be cut with a knife that should then be thoroughly cleaned.

When mixing or transferring a pesticide, the worker must always keep the product below eye level to minimize the change of splashing it into the face. If a splash or spill occurs during mixing or loading, the process should be stopped at once while workers remove contaminated clothing, wash thoroughly with detergent and water, and clean up the spill. Speed is essential!

Leaks and spills must be cleaned up promptly and in accordance with regulations. The first concern is to keep people away from the spill. The area should be roped off and flagged, and should not be left unattended while danger exists. Every effort should be made to confine the spill to a small area. If the spill is small, the worker may be able to accomplish the clean-up operation without help. Clean-up consists of (1) absorbing the

pesticide with dirt, sawdust, or another absorbent substance, (2) shoveling the contaminated material into a leakproof container, and (3) disposing of it in an approved manner.

After the spilled chemical has been removed, the area SHOULD NOT be hosed down, since this spreads any remaining chemical. The area where the spill occurred should be treated with a substance that will stop the chemical action. Common lye, ammonia, or chlorine bleach are sometimes indicated on the product label for this purpose.

If the spill is a large one, outside help may be needed. This help can be obtained by placing a toll-free call to The National Agricultural Chemicals Association Pesticide Safety Team Network. (The number is (800) 424-9300.) This organization can provide instructions in the correct procedure and will give referral to the appropriate local agency. In addition, if a major spill occurs along a state highway, the highway patrol or highway department should be notified. If food or water is contaminated by the spill, local and state health officials should be notified.

If a leaking container is discovered before a significant spill has occurred, it should be disposed of in the approved manner. Great care should be exercised in handling a leaking container, since there is a possibility of its rupturing and spilling the entire contents.

Good housekeeping practices can avoid many problems associated with agricultural chemical use. Both the mixing and the storage areas should be maintained so as to be clean, dry, and well ventilated at all times. Empty containers should be stored under similar conditions while awaiting disposal. All equipment used in the application of chemicals should be cleaned thoroughly before being put away even for a short time. The water used to wash equipment should be collected for disposal if it is likely that a substantial residue of poison remains.

Disposal of excess pesticide and of pesticide containers should be carried out according to EPA (Environmental Protection Agency) recommendations. If possible, these substances should be burned in a specially designed pesticide incinerator. If proper facilities for burning are not available, the pesticide and the containers should be buried in a specially

designated landfill. If that is not possible, the material must be stored until such time as it can be disposed of in one of these approved ways.

There are some additional ways in which containers, but not the chemicals themselves, can be disposed of properly. The EPA recommendations divide containers into three groups with specific directions for disposal of each. Group I containers are those that will burn and that held organic or metallo-organic pesticides (except those containing mercury, lead, cadmium, or arsenic). Group I containers may be burned in small numbers as permitted by state and local regulations or buried singly in open fields at a depth of at least 18 inches.

Group II containers are ones which held the same substances as Group I, but which will not burn. They may be rinsed according to established methods, making certain that rinse water is collected in a tank as specified. These containers can then be returned to the manufacturer for reuse, recycled as scrap metal, or buried according to state and local regulations.

Group III containers are those which held mercury, lead, cadmium, or arsenic compounds. These must not be burned, but should be buried either in a sanitary landfill, if rinsed, or in a specially designated landfill if not rinsed.

ACTIVITY 9:

List three actions that should be taken if a splash contaminates a worker who is mixing chemicals.

1. _____
2. _____
3. _____

OBJECTIVE 10: Discuss the use of labels and manufacturer's directions for storage and use of chemicals and pesticides.

The label attached to a product is one of the most valuable assets the agricultural chemical worker has. It serves several purposes:

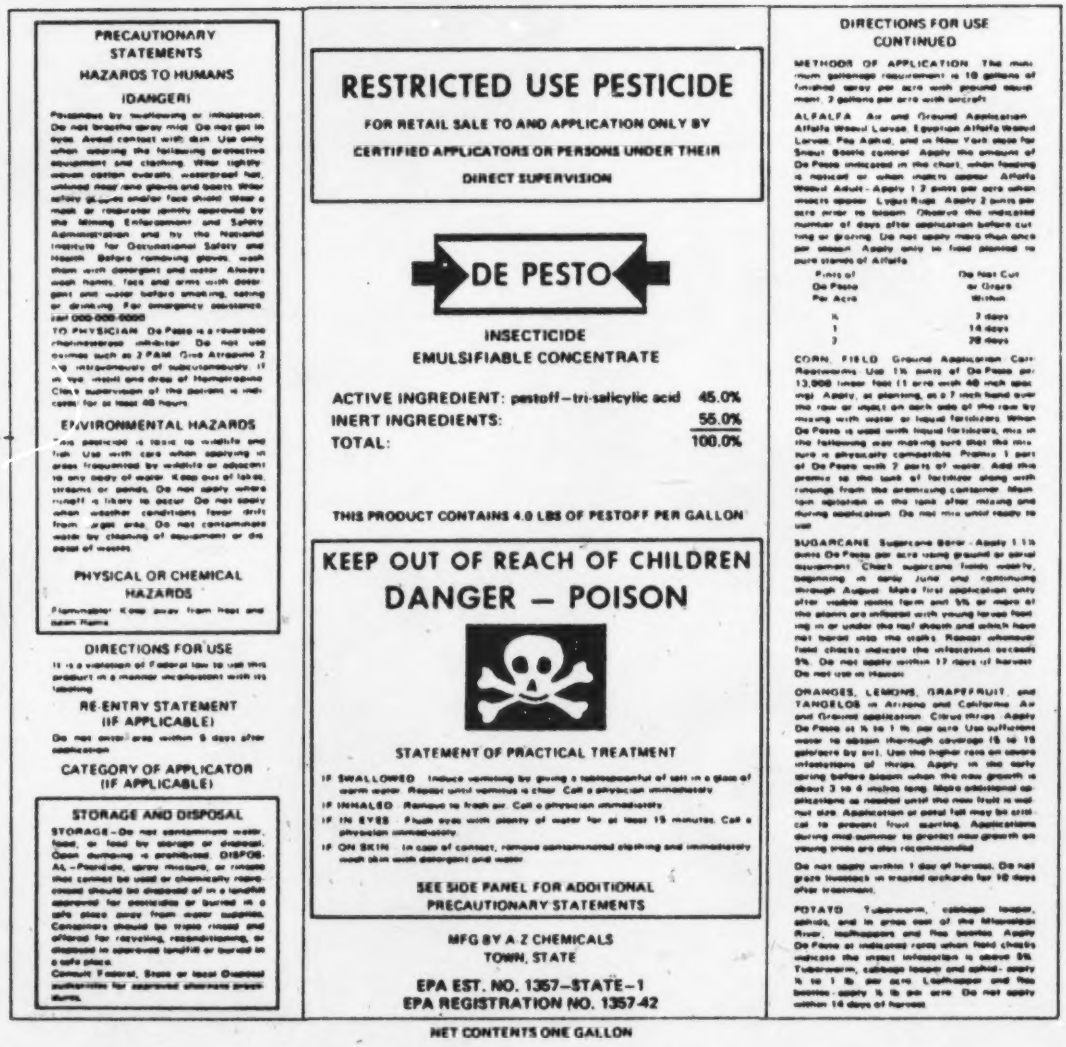
1. To the manufacturer, it is a license to sell.
2. To governmental agencies, it is a way to control distribution, storage, use, and disposal of the product.
3. To the user, it is the main source of facts about the proper and legal use of the product.
4. To everyone concerned, it is a way to tell about special safety measures needed.

The label is effective in use ONLY when it is read thoroughly, understood completely, and followed faithfully.

The sample label in Figure 4 shows all the types of information that must appear on a product. Most of the information found on a label is clear and easily understood to people who work with chemicals. However, there are several topics that may require more explanation. One of those is the "Re-Entry Statement." This tells how long after the application it will be before it is safe for an unprotected person to enter the area. This is especially important where fields have been sprayed, or where stored grains have been fumigated.

Another topic that may be unclear is "Category of Applicator." This refers to a classification system based upon study, testing, and licensing of people who apply toxic chemicals. The certification of pest control applicators is under the jurisdiction of both state and federal governments. A chemical that is designed "For Restricted Use" can only be sold to and used by persons certified by one or both levels of government.

Of particular importance on any label are the signal words and symbols. To do their job, most pesticides must control the target pest. By their nature, they are toxic. Therefore, many are also hazardous to people. The toxicity of a product can be determined by reading the signal word and looking at the symbol on the label. The signal word tells approximately how toxic the material is to humans. The signal words shown in Table 1 are set by law. Each manufacturer must use the correct one on every label.



PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS

(DANGER)

Poisonous by swallowing or inhalation. Do not breathe spray mist. Do not get in eyes. Avoid contact with skin. Use only when wearing the following protective equipment and clothing. Wear tightly woven cotton overalls, waterproof hat, unlined rubber gloves and boots. Wear safety glasses and/or face shield. Wear a mask or respirator jointly approved by the Mining Enforcement and Safety Administration and by the National Institute for Occupational Safety and Health. Before removing gloves, wash them with detergent and water. Always wash hands, face and arms with detergent and water before smoking, eating or drinking. For emergency assistance call 000-000-0000.

TO PHYSICIAN: De Pesto is a reversible cholinesterase inhibitor. Do not use oximes such as 2 PAM. Give Atropine 2 mg. intravenously or subcutaneously. If in eye, instill one drop of Homatropine. Close supervision of the patient is indicated for at least 48 hours.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to wildlife and fish. Use with care when applying in areas frequented by wildlife or adjacent to any body of water. Keep out of lakes, streams or ponds. Do not apply where runoff is likely to occur. Do not apply when weather conditions favor drift from target area. Do not contaminate water by cleaning of equipment or disposal of wastes.

PHYSICAL OR CHEMICAL HAZARDS

Flammable. Keep away from heat and open flame.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

RE-ENTRY STATEMENT (IF APPLICABLE)

Do not enter area within 5 days after application.

CATEGORY OF APPLICATOR (IF APPLICABLE)

STORAGE AND DISPOSAL

STORAGE - Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. DISPOSAL - Pesticide, spray mixtures, or rinsate that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticides or burned in a safe place away from water supplies. Containers should be triple rinsed and offered for recycling, reconditioning, or disposed in approved landfill or burned in a safe place.

Consult Federal, State or local Disposal authorities for approved alternate procedures.

RESTRICTED USE PESTICIDE

FOR RETAIL SALE TO AND APPLICATION ONLY BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION

DE PESTO

INSECTICIDE
EMULSIFIABLE CONCENTRATE

ACTIVE INGREDIENT: pestoff - tri-salicylic acid	45.0%
INERT INGREDIENTS:	55.0%
TOTAL:	100.0%

THIS PRODUCT CONTAINS 4.0 LBS OF PESTOFF PER GALLON

KEEP OUT OF REACH OF CHILDREN

DANGER — POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: Induce vomiting by giving a tablespoonful of salt in a glass of warm water. Repeat until vomitus is clear. Call a physician immediately.

IF INHALED: Remove to fresh air. Call a physician immediately.

IF IN EYES: Flush eyes with plenty of water for at least 15 minutes. Call a physician immediately.

IF ON SKIN: In case of contact, remove contaminated clothing and immediately wash skin with detergent and water.

SEE SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

MFG BY A-Z CHEMICALS
TOWN, STATE

EPA EST. NO. 1357-STATE-1
EPA REGISTRATION NO. 1357-42

NET CONTENTS ONE GALLON

DIRECTIONS FOR USE CONTINUED

METHODS OF APPLICATION: The minimum gallonage requirement is 10 gallons of finished spray per acre with ground equipment, 2 gallons per acre with aircraft.

ALFALFA: Air and Ground Application. Alfalfa Weevil Larvae, Egyptian Alfalfa Weevil Larvae, Pea Aphid, and in New York state for Sweet Beetle control. Apply the amount of De Pesto indicated in the chart, when feeding is noticed or when insects appear. Alfalfa Weevil Adult - Apply 1 1/2 pints per acre when insects appear. Lygus Bugs: Apply 2 pints per acre prior to bloom. Observe the indicated number of days after application before cutting or grazing. Do not apply more than once per season. Apply only to fields planned to pure stands of Alfalfa.

Pints of De Pesto Per Acre	Do Not Cut or Graze Within
½	7 days
1	14 days
2	28 days

CORN, FIELD: Ground Application Corn Rootworms: Use 1½ pints of De Pesto per 13,000 linear feet (1 acre) with 40 inch spacings. Apply, at planting, as a 7 inch band over the row or inject on each side of the row by mixing with water or liquid fertilizers. When De Pesto is used with liquid fertilizers, mix in the following way making sure that the mixture is physically compatible: Prepare 1 part of De Pesto with 2 parts of water. Add this premix to the tank of fertilizer along with rinsings from the premixing container. Maintain agitation in the tank after mixing and during application. Do not mix until ready to use.

SUGARCANE: Sugarcane Borer - Apply 1 1½ pints De Pesto per acre using ground or aerial equipment. Check sugarcane fields weekly, beginning in early June and continuing through August. Make first application only after visible holes form and 5% or more of the plants are infested with young larvae feeding in or under the leaf sheath and which have not bored into the stalks. Repeat whenever field checks indicate the infestation exceeds 5%. Do not apply within 17 days of harvest. Do not use in Hawaii.

ORANGES, LEMONS, GRAPEFRUIT, and TANGELOS in Arizona and California: Air and Ground application. Citrus thrips: Apply De Pesto at ½ to 1 lb. per acre. Use sufficient water to obtain thorough coverage (5 to 15 gallons by air). Use the higher rate on severe infestations of thrips. Apply in the early spring before bloom when the new growth is about 3 to 4 inches long. Make additional applications as needed until the new fruit is well set. Application of petrol fall may be critical to prevent frost scarring. Applications during mid summer to protect new growth on young trees are also recommended.

Do not apply within 1 day of harvest. Do not graze livestock in treated orchards for 10 days after treatment.

POTATO: Tuberworm, cabbage looper, aphids, and in areas east of the Mississippi River, leafhoppers and flea beetles. Apply De Pesto at indicated rates when field checks indicate the insect infestation is above 5%. Tuberworm, cabbage looper and aphid - apply ½ to 1 lb. per acre. Leafhopper and flea beetles - apply ½ lb. per acre. Do not apply within 14 days of harvest.

Figure 4. Sample of label that would be found on a pesticide.

TABLE 1. SIGNAL WORDS

*Signal Words	Toxicity	Approximate Amount Needed to Kill the Average Person
DANGER	Highly toxic	a taste to a teaspoonful
WARNING	Moderately toxic	a teaspoonful to a tablespoonful
CAUTION	Low toxicity or Comparatively free from danger	an ounce to more than a pint

*All products must bear the statement "Keep out of reach of children."

One of the best ways to catch a person's eye is with symbols. This is why a skull and crossbones symbol is used on all highly toxic materials along with the signal word DANGER and the word POISON. It is also very important for the user to know when and where a certain chemical can be properly used. The "Danger," "Environmental Hazards," and "Crop" statements all address this topic. Misuse of a hazardous chemical is a violation of the law as well as a dangerous act to both humans and the environment.

Most suggestions for safe storage of pesticides and other chemicals have been discussed elsewhere in this module. However, because of the critical importance of these ideas, they are summarized below:

- Store in a well ventilated area.
- Storage in a separate building is preferable; however, isolated storage rooms can be used in certain instances.
- Always store pesticides in the original containers with the label intact and legible.
- Do not locate storage near food, feed, or seed.
- Post the storage area with signs at each point of entry and on all sides of the building.

- Keep storage area locked when not in use.
- Keep a log of pesticides and the amounts of each in storage as well as the date purchased.
- Fireproof the storage area to the extent possible.
- Check containers periodically for corrosion, leaks, breaks, tears, and so forth.
- Store "empty containers" in the storage area, pending disposal.

While manufacturer's labels give as much information as is possible in the available space, they do not ensure safe use of these chemicals. Only the user can accept final responsibility for the safe use of these valuable materials. Educated persons who are aware of safety principles and are concerned for themselves, for other people, and for the environment provide the greatest assurance that agricultural chemicals will be used for the good of all.

ACTIVITY 10:

(Fill in the blanks.)

1. Three "signal words" that are required to be used on the labels of poisonous chemicals are _____, _____ and _____
2. _____ is the most responsible for the safe use of agricultural chemicals and pesticides.

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U.S. Department of Agriculture. Pesticide Safety in Your Home. Washington, D.C.: U.S. Department of Agriculture, Office of Information.

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ANSWERS TO ACTIVITIES

ACTIVITY 1

1. a. Agricultural chemicals are those substances or mixtures of substances that are commonly used in the production of or protection of food, fiber, and forest products.

   b. A pesticide is a substance that kills pests such as unwanted plants, rodents, and insects.

   a. USDA.

   b. EPA.

   c. OSHA.

ACTIVITY 2

1. skin, respiratory tract, mouth (digestive system).

2. a. (Any one.) food and drinks must be kept isolated from areas of possible contamination; hands should be thoroughly washed before handling food or drink.

   b. (Any one.) Wear respirators; use appropriate ventilation; take care in handling and storing so airborne contaminants will be reduced.

   c. (Any one.) Wear protective clothing (neoprene or rubber gloves); remove contaminated clothing carefully; wash skin thoroughly.

ACTIVITY 3

1. Fire and explosion, leaks and spills.
2. a. The location of fire fighting equipment.
   b. The type of equipment available.
   c. The correct procedure for its use.

ACTIVITY 4

1. True (a)
   True (c)
   True (d)
2. Flush eye immediately and continuously for 15 minutes with large amounts of clean water.

ACTIVITY 5

goggles, mask.

ACTIVITY 6

1. (a)
   (b)
2. (Any four.)

   The worker should wear protective clothing, such as rubber gloves and aprons.

   The worker should wash hands (fingernails), body and hair after using hazardous chemicals.

   Clean clothes should be worn each day, and care should be taken to see that clothing is thoroughly washed after wearing.

   Water resistant shoes should be worn when working around liquid chemicals.

   Seek medical help if symptoms of poisoning appear.

ACTIVITY 7

1. Chemical cartridge respirator for intermittent exposure.
2. Chemical canister or gas mask for continuous exposure.
3. Supplied-air respirator for use with low oxygen supply.
4. Self-contained breathing apparatus for use in low oxygen areas not near a fresh oxygen supply.

ACTIVITY 8

(Any two of the following.)

Toxic chemicals can be ingested into the body accidentally

1. when the chemicals are splashed into the mouth.
2. when the chemical are mistaken for something else because they are stored in food containers.
3. when chemicals are on the unwashed hands of a person who works with chemicals and then eats or drinks.
4. when chemicals contaminate food or drinking water.

ACTIVITY 9

1. The operation must be stopped so the worker can remove contaminated clothes.
2. All affected skin areas should be washed thoroughly and immediately.
3. The spill should be cleaned up before operations are resumed.

ACTIVITY 10

1. Danger, warning, and caution.
2. The user.